CLAIMS

1. An electrode structure used in a plasma processing apparatus which performs a predetermined process on an object (W) to be processed by using a plasma in a process chamber (26) in which a vacuum can be formed, the electrode structure is characterized by comprising:

an electrode unit (38; 110) having a heater unit (44; 116) therein;

a cooling block (40; 112) joined to the electrode unit and having a cooling jacket (58; 126) which cools said electrode unit;

a heat resistant metal seal member (66A, 66B, 68A, 68B; 132A, 132B, 134A, 134B) for sealing an electrode-side heat transfer space (62, 64; 128, 130) formed between said electrode unit and said cooling block; and

electrode-side heat transfer gas supply means (94; 142) for supplying a heat transfer gas to said electrode-side heat transfer space.

2. An electrode structure used in a plasma processing apparatus which performs a predetermined process on an object (W) to be processed by using a plasma in a process chamber (26) in which a vacuum can be formed, the electrode structure is characterized by comprising:

an electrode unit (38; 110) having a heater unit (44; 116) therein;

a cooling block (40; 112) joined to the electrode unit and having a cooling jacket (58; 126) which cools said electrode unit;

a labyrinth heat transfer space (154) formed by a concentric or spiral groove (150) provided on at least

one of opposite surfaces of said electrode unit and said cooling block; and

electrode-side heat transfer gas supply means (94; 142) for supplying a heat transfer gas to said labyrinth heat transfer space.

3. The electrode structure as claimed in claim 1 or 2, characterized in that an insulating member (42; 114) is provided between said electrode unit (38; 110) and said cooling block (40; 112), and said heat transfer space (62, 64; 128, 130) is divided into an upper space (62, 128) and a lower space (64, 130) by the insulating member.

4. The electrode structure as claimed in claim 3, characterized in that said insulating member (42; 114) is made of a material having a coefficient of thermal conductivity of more than 80 W/mK.

5. The electrode structure as claimed in claim 4, characterized in that said insulating member (42; 114) is made of aluminum nitride (AlN).

6. The electrode structure as claimed in claim 1 or 2, characterized in that a contact rate of a joining surface of a member, which is joined to define said heat-transfer space (62, 64; 128, 130; 154), is set to fall within a range from 40% to 80%.

7. The electrode structure as claimed in claim 1 or 2, characterized in that a surface roughness of a member defining said heat transfer space (62, 64; 128, 130; 154) is smaller than 2.0 im.

8. The electrode structure as claimed in claim 1, characterized in that said heat resistant metal seal member (66A, 66B, 68A, 68B; 132A, 132B, 134A, 134B) is a heat resistant metal film (79) having a ring-like cross section, a low melting point material (84) being confined in the metal film.

9. The electrode structure as claimed in claim 1, characterized in that a surface of said heat resistant metal seal member (66A, 66B, 68A, 68B; 132A, 132B, 134A, 134B) is covered by a soft metal film (206) made of a low melting point material which is softened at a process temperature of said object (W) to be processed.

10. The electrode structure as claimed in claim 1, characterized in that a surface of a member contacting said heat resistant metal seal member (66A, 66B, 68A, 68B; 132A, 132B, 134A, 134B) is covered by a soft metal layer (208) made of a low melting point material which is softened at a process temperature of said object (W) to be processed.

11. The electrode structure as claimed in claim 1, characterized in that a surface of said heat resistant metal seal member (66A, 66B, 68A, 68B; 132A, 132B, 134A, 134B) is covered by a fluoride passivation film (210) having a corrosion resistance with respect a fluoride gas.

12. The electrode structure as claimed in claim 11, characterized in that said fluoride passivation film (210) is made of nickel fluoride.

13. The electrode structure as claimed in claim

1 or 2, characterized in that said heater unit (44; 116) is a ceramic heater.

14. The electrode structure as claimed in claim 1 or 2, characterized in that said heater unit (44; 116) is divided into concentric zones, and the divided zones are controllable on an individual basis.

15. The electrode structure as claimed in claim 1 or 2, characterized in that said electrode unit (38; 110) is an upper electrode unit (110) positioned above said object (W) to be processed.

16. The electrode structure as claimed in claim 1 or 2, characterized in that said electrode unit (38; 110) is a lower electrode unit (38) which also serves as a placement table on which said object (W) to be processed is placed, and the electrode structure further comprises an electrostatic chuck (46) which is joined to an upper surface of the lower electrode unit so as to attract said object (W) to be processed and a chuck-side heat transfer gas supply means (96) for supplying a heat transfer gas to a chuck-side heat transfer space (74) formed between said electrostatic chuck and said object to be processed.

17. The electrode structure as claimed in claim 16, characterized in that at least one of said electrode-side heat transfer space (62, 64; 128,130), said labyrinth heat transfer space (154) and said chuck-side heat transfer space (74) is provided with a heat resistant pressure sensor, and an amount of gas supplied by said corresponding heat transfer gas supply means is controlled based on an output of the heat resistant pressure sensor.

18. The electrode structure as claimed in claim 1 or 2, characterized in that the center of said electrode unit (38; 110) is held by a hollow column (48), and gas blower means (222) is provided in said column for promoting a release of heat by blowing a gas toward the center of a back surface of said electrode unit.

19. The electrode structure as claimed in claim 1 or 2, characterized in that the center of said electrode unit (38; 110) is held by a column (48), and the column is connected to said cooling block (40; 112) via a heat conductive member.

20. A placement table structure used for a processing apparatus performing a predetermined process on an object (W) to be processed in a process chamber (26) in which a vacuum can be formed, the placement table structure is characterized by comprising:

a placement table (164) having a heater unit (44) therein so as to heat said object to be processed;

a cooling block (40) joined to the placement table and having a cooling jacket (58) which cools said placement table (164);

a heat resistant metal seal member (66A, 66B) for sealing a heat transfer space (62) formed between said placement table and said cooling block; and

heat transfer gas supply means (94) for supplying a heat transfer gas to said heat transfer space.

21. The placement table structure as claimed in claim 20, characterized in that a surface of said heat resistant metal seal member (66A, 66B, 68A, 68B; 132A,

132B, 134A, 134B) is covered by a soft metal film (206) made of a low melting point material which is softened at a process temperature of said object (W) to be processed.

22. The placement table structure as claimed in claim 20, characterized in that a surface of a member contacting said heat resistant metal seal member (66A, 66B, 68A, 68B; 132A, 132B, 134A, 134B) is covered by a soft metal layer (208) made of a low melting point material which is softened at a process temperature of said object (W) to be processed.

23. The placement table structure as claimed in claim 20, characterized in that a surface of said heat resistant metal seal member (66A, 66B, 68A, 68B; 132A, 132B, 134A, 134B) is covered by a fluoride passivation film (210) having a corrosion resistance with respect a fluoride gas.

24. The placement table structure as claimed in claim 23, characterized in that said fluoride passivation film (210) is made of nickel fluoride.

25. A placement table structure used for a processing apparatus performing a predetermined process on an object (W) to be processed in a process chamber (26) in which a vacuum can be formed, the placement table structure is characterized by comprising:

a placement table (164) having a heater unit (44) therein so as to heat said object to be processed;

a cooling block joined to the placement table and having a cooling jacket (58) which cools said placement table (164);

a labyrinth heat transfer space (154) formed by a concentric or spiral groove (150) provided on at least one of opposite surfaces of said placement table and said cooling block; and

heat transfer gas supply means (94) for supplying a heat transfer gas to said labyrinth heat transfer space.

26. The placement table structure as claimed in claim 25, characterized in that a rate of contact of a joining surface of a member joined to define said heat transfer space (154) is set to fall within a range from 40% to 80%.

27. The placement table structure as claimed in claim 25 or 26, characterized in that a surface roughness of a member defining said heat-transfer space (154) is smaller than 2.0 im.

28. The placement table structure as claimed in claim 25, characterized in that the center of said placement table (164) is held by a hollow column (48), and gas blower means (222) is provided in said column for promoting a release of heat by blowing a gas toward the center of a back surface of said electrode unit.

29. The placement table structure as claimed in claim 25, characterized in that the center of said placement table (164) is held by a column (48), and the column is connected to said cooling block (40) via a heat conductive member.

30. A plasma processing apparatus characterized

by comprising:

a process chamber (26) in which a vacuum can be formed;

an electrode structure (28, 30) recited in one of claims 1 to 19; and

a high-frequency source (56) applying a high-frequency voltage to the electrode structure.

31. A processing apparatus characterize by comprising:

a process chamber (26) in which a vacuum can be formed; and

a placement table structure (162) recited in one of claims 20 to 29.